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# DESIGN AND CHARACTERIZATION OF THE DC ACCELERATION AND TRANSPORT SYSTEM REQUIRED FOR THE FOM 1 MW FREE ELECTRON MASER EXPERIMENT

Caplan, M. *, Urbanus, W. H. **, van der Geer, C. **,
Valentini, M.**
*Lawrence Livermore National Laboratory, Livermore, CA 94550 USA
**FOM-Instituut voor Plasma Fysica, Rijnhuizen, Nieuwegein, The Netherlands

A Free Electron Maser (FEM) has been constructed and is soon to be tested at the FOM Institute (Rijnhuizen) Netherlands with the goal of producing 1 MW long pulse to CW microwave output in the range 130 GHz to 250 GHz. The design uses a DC beam system in a depressed collector configuration in order to make the overall wall plug efficiency 50%. The high voltage (~ 2 MeV) power supply provides only the body interception current (~ 30 mA) while the 12 amp beam current is supplied by the 100-200 keV collector supplies. Some of the design features to ensure low interception current, which is critical to long pulse (CW) operation are:

(1) DC beam in-line transport and acceleration system
(2) emittance conserving solenoid focusing system
(3) halo suppression techniques at cathode edge
(4) very low beam fill factor (< 20%)

A relativistic version of the Herman Optical theory developed for microwave tubes is used to determine current distribution functions everywhere along the beam from the electron gun, through the DC accelerator and transport system to the wiggler. This theory takes into account thermals far out on the gaussian tail which translates into beam current far outside the ideal beam edge. This theory is applied to the FOM beam line design to predict a series of beam envelope contours containing various percentages of total beam current up to 99.9%. Predictions of body interception current due to finite emittance (effective temperature) are presented and compared with measured experimental results.

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